Electrical Notes.

Electricians have taken no little pride in the splendid electrical display made in the Metropolitan Opera House, New York, in honor of Prince Henry at the gala performance. Some 8,500 extra lamps were required. Not until two days before the performance was the placing of the lamps begun.

The United States Navy Department has placed with the Allgemeine Elektricitaets Gesellschaft an order for a complete outfit of Slaby-Arco wireless telegraphy instruments. Secretary Long has decided to test the various systems of wireless telegraphy which are now in use in this country and abroad, in order to obtain accurate data of their comparative efficiency.

The darkness that has pervaded the Pyramids for thousands of years is now to be dispelled by the electric light. Maspero, the director of the society intrusted with the preservation of Egyptian antiquities, has begun work on the historic temple of Karnak at Thebes. So successful has the result been that the inner passages and catacombs of the great Pyramids are now to be lighted.

Although platinum is now obtainable from ruthrnium, F. Foerster says that it is still too expensive for many commercial uses, such as the electrolysis of salt solutions for making chlorides and soda. For this purpose carbon anodes are employed, although experience has shown that they are in no sense refractory to the electrolyte. Using graphite and molded carbon anodes of different makes for the electrolysis of a salt solution, Foerster found that while graphite showed least waste, it was closely followed in efficiency by the best of the molded carbons. The waste arises in the main from the oxidation of carbon, although there is also a loss due to disintegration.

The experiments upon the Berlin-Zossen high-speed electric railroad have come to an abrupt and unsatisfactory conclusion. It was originally anticipated that the special car built for the purpose would attain a speed of 125 miles an hour. A velocity of only 100 miles an hour was reached, however, and that only for a brief space of time. The effect of this high speed upon the track was so destructive that the attempt to make higher speeds was discontinued. The Berlin-Zossen military track was practically a straight line, so that the experiments, even if successful, would have not substantiated the possibility of running trains safely round sharp curves at these terrific speeds on a two-rail track.

In an article printed in the Physikalische Zeitschrift K. R. Koch states that he has found that lightning conductors, the connections of which have become imperfect through rusting, nevertheless act in an efficient manner during a thunderstorm. In his opinion this phenomenon is due to the oscillating character of a lightning discharge. Electro-magnetic waves have been produced, which act upon the imperfect connections as upon a coherer, restoring the conductivity for a period more or less long. Hitherto lightning has been considered a continual discharge, which often becomes apparently oscillatory by quick repetition. In order to prove his theory experimentally Koch employed a rapidly revolving camera. Unfortunately he has not been able to furnish as complete a proof of his theory as might be desired, for the flashes photographed were all too distant.

An electrical coin or metal detector is a device for which two Pittsburg inventors, Francis E. J. Litot and Adolphus Mayer, have received a patent. The apparatus is designed automatically to test the difference in quantity or quality of metals, and to separate good from bad coin. The principle of the operation consists in the use of primary coils, in inductive relation to which secondary coils are placed. Electromotive forces are thereby produced in the secondary coils, which forces are equal and oppose each other. Inductive force of the primary coils on the secondary coils is varied by the insertion of metallic substances between them having different inductive effects. This variation of the electromotive forces in the secondary coils sets up a current in the relay, producing motion which closes the circuit of the magnet controlling the operating mechanism.

The first practical trial of a new system of the single-rail railroad is to be made at the Crystal Palace, London. The line, which is to be one and a half miles in length, will be worked by electricity. One terminus will be alongside the low-level station of the London and Brighton and South Coast Trunk Railway. Thence it will run up the hill to the Palace Buildings and around the lakes in the grounds. The difference between this system and the prevalent type of mono-rail is that the line is on the ground, and large wheels projecting from the middle of the carriage run on it, while on each side of the carriage there are safety rollers upon guide rails. In the mono-rail the line is elevated, with the carriages overhanging on each side, thus placing the center of gravity below the rail. The experimental railroad will cost $70,000, and the line will be in working order by July.

LIGHTNING ABOVE AND BELOW WATER.

BY PROF. JOHN TROWBRIDGE.

I believe that the following experiments show that lightning never strikes the surface of the sea. In studying the spectrum of water vapor, I have often endeavored to pass powerful sparks to the surface of water, in order to obtain a strong spectrum from the resulting volatilization. In every case sparks of high electromotive force resembling, as far as possible, lightning discharges, being with my apparatus six feet in length, refuse to strike the surface of a level basin of water, and pass to the edges of the containing vessel. Even if the terminal is brought close to the surface of the water, only a brush discharge manifests itself. In one experiment I inclosed water in the ends of a vacuum tube, Fig. 1. Having exhausted the tube to the point of the vapor tension of water, I endeavored to force a discharge from the surface of the water, *A*, to that of *B*. This was found to be impossible.

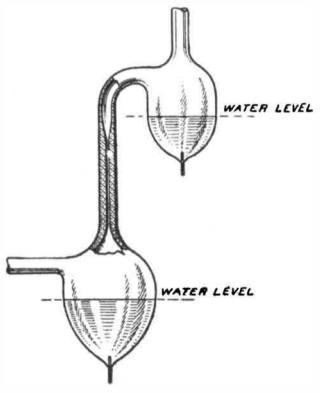

Fig. 1.—VACUUM TUBE CONTAINING WATER.

I was led to these experiments with the desire to obtain a spectrum of water vapor which would be free from all suspicion of the metallic lines of the terminals employed. Subsequent experiments, however, convinced me that with long sparks no metallic lines showed themselves at a distance of even two inches from the terminals. If the quantity of the discharge is made very large by the use of a powerful induction coil actuated by a Wehnelt or liquid interrupter, the metallic lines can be seen further than two inches from the metallic terminals.

It is also extremely difficult to pass powerful sparks from one stream of water to another. In this case we also have two liquid terminals free from any suspicion of contamination of metallic spectra. My apparatus was arranged as shown in Fig. 2. A step-up transformer, giving powerful discharges with a difference of potential of one or two hundred thousand volts, was connected to two vessels of water which delivered two streams of water. It was interesting to see the two streams approach each other under the effect of the alternating plus and minus charges. When the streams were attracted sufficiently near each other, a spark passed which, on account of the high resistance of the water, did not give sufficient light for spectrum analysis. When salt was dissolved in the water, a brilliant spectrum of sodium vapor was obtained. The experiment affords a good class illustration of the attraction of alternating currents, but did not serve my purpose in studying water vapor. It does not seem probable that lightning discharges pass through regions in the air of heavy rainfall.

Fig. 2.—EXPERIMENT WITH STREAMS OF WATER.

Lightning discharges which seem to strike the sea really pass from one region of the air to another, and it is only perspective which leads one to suppose that the discharges strike the water. It is remarkable that

Fig. 3.—SPECTRUM OF WATER VAPOR.

sufficient electric density can accumulate in the clouds to allow a discharge from one region to another. I have reason to believe from my experiences with powerful discharges that we underrate the quantity and voltage of lightning.

Benjamin Franklin would never have tried his famous experiment if he had previously used an apparatus similar to mine.

Having failed to obtain the water-vapor spectrum with the use of water terminals, I turned my attention to the production of the electric spark under water. Certainly in this case I should have the light of aqueous vapor in excess of the light of the metallic terminals. I found it was difficult to produce a spark under distilled water by the simple immersion of the terminals. It was necessary to seal platinum wires in glass tubes, and these wires should not emerge from the glass tubes to a greater distance than half an inch, and moreover should be immersed but a short distance below the surface of the water, if the water is contained in a glass tube of not more than two inches in diameter. If they are immersed to a depth of even two inches, the sparks I employ will instantly shatter the glass tube. The light of the electric spark under water is extremely brilliant, and resembles that of an inclosed arc lamp. There are no lines, however, in its spectrum. The spectrum, in other words, is continuous and like that of an incandescent solid. How shall we picture to ourselves the formation of this light? Is it due to the combustion of oxygen and hydrogen which are set free from the water, or is it possible that the particles of water vapor sufficiently removed from a state of continuity can become incandescent? The spectrum of powerful electric sparks in the atmosphere also shows a continuous spectrum underlying the bright lines which are due to oxygen, hydrogen and nitrogen. It is probable that this continuous spectrum is due to water vapor. The various spectra of lightning obtained by different observers are due to different amounts of water vapor in the air.

Here is the water-vapor spectrum combined with air lines (Fig. 3), the study of which led me to these experiments with electric sparks above and below the surface of water. It consists of a continuous spectrum with marked bands and collection of fine lines, which are collected together especially in the blue and violet parts of the spectrum, which is represented in the accompanying photograph.

I have said that it was necessary to be careful with the employment of powerful sparks beneath water or oil in glass tubes smaller than two inches in diameter. The glass is immediately shattered by an explosion which is not due to heated air suddenly expanding. I am inclined to attribute the explosion to the combination of hydrogen with bubbles of air or oxygen. The dielectric is filled with a fine cloud of gaseous particles. When the surface of the water is covered by a thin film of oil, the water immediately, under the effect of the electric discharge, becomes opalescent and remains so for weeks. Thus we have an interesting case of troubled solutions. It seems to be an electric emulsion formed by the liberation of extremely minute particles of gas or air, which become coated by oil, and we thus have a medium filled with millions of minute soap bubbles.

In Fig. 3 the broader spectrum is that of water vapor and air lines in the blue and violet. The narrower spectrum is that of the corresponding regions in the sun's spectrum. The photograph was taken with a Rowland concave grating and is therefore normal.

The explosion is analogous to that of a dust explosion, with minute bubbles of gas instead of minute particles of carbonaceous matter submitted to quick combustion. It may be that the report of lightning, apart of course from the rolling of the thunder, is due to the explosion of the dissociated gas particles. When lightning exhibits a zigzag path, it occurs in low regions of the atmosphere, certainly below a thousand feet. Its spectrum will therefore show the ordinary atmospheric lines with a continuous spectrum underlying, which is intensified where the hydrogen and aqueous lines occur, as is seen in the accompanying photograph. The hydrogen lines are very broad. When the discharge is above a thousand feet it loses its zigzag character, and with the same voltage as in lower altitudes can be of great length. At still higher regions we have the aurora. Water vapor plays a controlling part in all these phases of lightning.

A New Process of Preserving Butter.

The researches of Fehling have established the fact that gum-arabic and its concentrated solutions are not fermentable. Emile de Meulemeester, of Brussels, Belgium, has found by numerous experiments that, by mixing powdered gum-arabic with butter in the requisite proportions for absorbing the water, the butter can be kept for a long period without becoming rancid. If a small quantity of salt be added the butter will preserve its aroma. This method of procedure is objectionable because it requires too large a proportion of gum-arabic and because the gum should be free from impurities. It is difficult to procure pure gum in large quantities, and its price would speedily become prohibitive if the consumption were large. In order to obviate these disadvantages M. de Meulemeester proceeds in the following manner: Raw gum-arabic is dissolved in water and the solution filtered to remove the impurities. The filtered solution is then mixed with the butter and the excess of liquid contained in the mixture is finally extracted.